Proposed Registration Decision PRD2017-07

Saflufenacil

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Overview

Proposed Registration Decision for Saflufenacil

Health Canada's Pest Management Regulatory Agency (PMRA), under the authority of the *Pest Control Products Act* and Regulations, is proposing full registration for the sale and use of saflufenacil technical, Kixor and the herbicide end-use product, Detail, containing the technical grade active ingredient saflufenacil, to control broadleaf weeds in non-cropland areas.

Saflufenacil is currently registered for use to control broadleaf weeds in lentils, soybean, barley, canary seed, chickpea, field corn, sweet corn, oats, dried field peas, wheat (spring, durum and winter) and in chemfallow. The detailed review of saflufenacil can be found in the Proposed Regulatory Decision 2009-18, *Saflufenacil* and the Registration Decision RD2010-05, *Saflufenacil*.

An evaluation of available scientific information found that, under the approved conditions of use, the product has value and does not present an unacceptable risk to human health or the environment.

This Overview describes the key points of the evaluation, while the Science Evaluation provides detailed technical information on the human health, environmental and value assessments of Kixor and Detail.

What Does Health Canada Consider When Making a Registration Decision?

The key objective of the *Pest Control Products Act* is to prevent unacceptable risks to people and the environment from the use of pest control products. Health or environmental risk is considered acceptable[1] if there is reasonable certainty that no harm to human health, future generations or the environment will result from use or exposure to the product under its proposed conditions of registration. The Act also requires that products have value[2] when used according to the label directions. Conditions of registration may include special precautionary measures on the product label to further reduce risk.

To reach its decisions, the PMRA applies modern, rigorous risk-assessment methods and policies. These methods consider the unique characteristics of sensitive subpopulations in humans (for example, children) as well as organisms in the environment. These methods and policies also consider the nature of the effects observed and the uncertainties when predicting the

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1 "Acceptable risks" as defined by subsection 2(2) of the *Pest Control Products Act*.

2 "Value" as defined by subsection 2(1) of the *Pest Control Products Act*: "...the product's actual or potential contribution to pest management, taking into account its conditions or proposed conditions of registration, and includes the product's (*a*) efficacy; (*b*) effect on host organisms in connection with which it is intended to be used; and (*c*) health, safety and environmental benefits and social and economic impact."

impact of pesticides. For more information on how the PMRA regulates pesticides, the assessment process and risk-reduction programs, please visit the Pesticides and Pest Management portion of Health Canada's website at healthcanada.gc.ca/pmra.

Before making a final registration decision on saflufenacil, the PMRA will consider any comments received from the public in response to this consultation document.[3] The PMRA will then publish a Registration Decision[4] on saflufenacil, which will include the decision, the reasons for it, a summary of comments received on the proposed final registration decision and the PMRA's response to these comments.

For more details on the information presented in this Overview, please refer to the Science Evaluation of this consultation document.

What Is Saflufenacil?

Saflufenacil is the active ingredient in the herbicide end-use product, Detail. It is a contact herbicide for control or suppression of multiple annual and perennial broadleaf weed species in non-cropland areas. Saflufenacil results in cell membrane destruction and necrosis. The foliage of sensitive plants turns yellow and brown followed by death of the whole plant.

Saflufenacil is classified as a Group 14 herbicide by the Weed Science Society of America and as a Group E herbicide by the Herbicide Resistance Action Committee.

Health Considerations

Can Approved Uses of Saflufenacil Affect Human Health?

Products containing saflufenacil are unlikely to affect your health when used according to label directions.

Potential exposure to saflufenacil may occur through the diet (food and water), when handling and applying the products or when entering treated sites. When assessing health risks, two key factors are considered: the levels where no health effects occur and the levels to which people may be exposed. The dose levels used to assess risks are established to protect the most sensitive human population (for example, children and nursing mothers). Only uses for which the exposure is well below levels that cause no effects in animal testing are considered acceptable for registration.

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3 "Consultation statement" as required by subsection 28(2) of the *Pest Control Products Act*.

4 "Decision statement" as required by subsection 28(5) of the *Pest Control Products Act*.

Toxicology studies in laboratory animals describe potential health effects from varying levels of exposure to a chemical and identify the dose where no effects are observed. The health effects noted in animals occur at doses more than 100-times higher (and often much higher) than levels to which humans are normally exposed when pesticide-containing products are used according to label directions.

In laboratory animals, saflufenacil was of low acute toxicity by the oral, dermal, and inhalation routes of exposure. It was not irritating to the eyes but was slightly irritating to the skin. Saflufenacil did not cause an allergic skin reaction.

Detail, containing saflufenacil, is of low acute toxicity by the oral, dermal, and inhalation routes of exposure. It is minimally irritating to the eyes and skin. The formulation did not cause an allergic skin reaction.

Registrant supplied short- and long-term (lifetime) animal toxicity studies were assessed for the potential of saflufenacil to cause neurotoxicity, chronic toxicity, cancer, reproductive and developmental toxicity, genetic damage, and various other effects. The most sensitive endpoints used for risk assessment were reduced activity, as well as effects on blood parameters, and development of the young. There was evidence that the young were more sensitive than the adult animals.

The risk assessment protects against these findings as well as any other potential effects by ensuring that the level of exposure to humans is well below the lowest dose at which these effects occurred in animal tests.

Residues in Water and Food

Dietary risks from food and drinking water are not of health concern.

Aggregate dietary intake estimates (food plus drinking water) revealed that the general population (excluding females 13-49 years of age), and infants less than one year old, the subpopulation which would ingest the most saflufenacil relative to body weight, are expected to be exposed to less than 51% of the acceptable daily intake (ADI). For females 13-49 years of age, aggregate dietary intake estimates are expected to be less than 41% of the ADI. Based on these estimates, the chronic dietary risk from saflufenacil is not of health concern for all population subgroups.

Acute dietary (food plus drinking water) intake estimates for all population subgroups (excluding females 13-49 years of age) were less than 2% of the acute reference dose (ARfD). For females 13-49 years of age, acute dietary exposure was 100% of the ARfD. Based on these estimates, the acute dietary risk from saflufenacil is not of health concern.

The *Food and Drugs Act* prohibits the sale of adulterated food, that is, food containing a pesticide residue that exceeds the established maximum residue limit (MRL). Pesticide MRLs are established for *Food and Drugs Act* purposes through the evaluation of scientific data under the *Pest Control Products Act*. Food containing a pesticide residue that does not exceed the established MRL does not pose an unacceptable health risk.

No food residue data are required to support the registration of saflufenacil for use in/on non-cropland areas in Canada. Please refer to the Maximum Residue Limit Database for all currently specified saflufenacil MRLs.

Occupational Risks From Handling the Herbicide End-Use Product, Detail

Occupational risks are not of concern when the herbicide end-use product, Detail, is used according to the proposed label directions, which include protective measures.

Workers who mix, load and apply Detail and workers re-entering recently treated non-cropland areas can come in direct contact with Detail residues on the skin. Therefore, the label specifies that workers must wear coveralls over a long-sleeved shirt and long pants, chemical-resistant gloves, and shoes plus socks during mixing, loading, applying, clean-up and repair. In addition, goggles or face shield must be worn during mixing/loading. Also, a closed mixing and loading system must be used when the spray will be applied with open-cab groundboom equipment.

The label also requires that workers and others not enter treated non-military base areas until 'sprays have dried' after an application; and military personnel do not enter treated military base areas for 2 days after an application. Taking into consideration these label statements, the single application and the expectation of the short exposure duration for handlers and postapplication workers, the risks to these individuals are not a concern.

For bystanders, exposure is much less than that for workers. Therefore, health risks to bystanders are not of concern.

Environmental Considerations

What Happens When Saflufenacil Is Introduced Into the Environment?

When used according to label directions, saflufenacil is not expected to pose risks of concern to the environment.

Saflufenacil will enter the environment when applied as the herbicide end-use product, Detail, to non-cropland areas for pre- and post-emergence control of weeds. Saflufenacil mixes readily in water. It is not expected to evaporate from moist soil and water surfaces and enter the atmosphere. Saflufenacil is broken down by chemical reactions and by microorganisms in soil and water. Saflufenacil is not expected to persist or build-up in soil and water. Several of the seven breakdown products that are formed in soil are more persistent than saflufenacil in laboratory studies and in field studies. Three of the four breakdown products formed in water are persistent, but will break down further in the presence of sunlight. Saflufenacil and its breakdown products are mobile in soil and have a high potential to move through soil to reach groundwater. Saflufenacil is not expected to build-up in the tissues of organisms.

Saflufenacil is toxic to terrestrial vascular plants if they are exposed to high enough levels. Risks to non-target terrestrial plants as a result of spray drift have been identified for areas adjacent to the treatment area. Therefore, appropriate precautionary label statements (for example, no-spray buffer zones) will be required. There are no concerns about saflufenacil or its major breakdown products affecting any other non-target organisms.

Value Considerations

What Is the Value of the Herbicide End-use Product Detail?

Detail is the first Group 14 herbicide that may be applied to emerged weeds, while providing residual control of certain weed species in non-cropland areas.

Detail, in combination with Merge or Hasten NT Spray Adjuvant, may be applied once per year using ground application equipment. Detail may be applied alone or tank mixed with other herbicides for broader spectrum weed control.

The only other Group 14 herbicide registered for application to non-cropland areas is applied prior to weed emergence while Detail is applied to emerged weeds. The application of Detail in tank mixtures or alternately with herbicides of differing modes of action can be expected to help mitigate the development of resistance to other herbicide chemistries applied in non-cropland areas for broadleaved weed control.

Measures to Minimize Risk

Labels of registered pesticide products include specific instructions for use. Directions include risk-reduction measures to protect human and environmental health. These directions must be followed by law.

The key risk-reduction measures being proposed on the label of Detail to address the potential risks identified in this assessment are as follows.

Key Risk-Reduction Measures

Human Health

To reduce the potential of users coming into direct contact with Detail on the skin or through inhalation of spray mists, workers must wear coveralls over a long-sleeved shirt and long pants, chemical-resistant gloves, and shoes plus socks during mixing, loading, and applying Detail, and during clean-up and repair. In addition, goggles or face shield must be worn during mixing/loading. Also, a closed mixing and loading system must be used when the spray will be applied with open-cab groundboom equipment; or closed-cab groundboom equipment must be used when using open mixing and loading equipment. A standard label statement to protect against drift during application is on the label.

The label also requires that workers and others not enter treated non-military base areas until 'residues have dried' after an application while military personnel must not enter treated military base areas for 2 days after an application.

Environment

To reduce exposure to non-target terrestrial plants, no-spray buffer zones of 20 metres are required to protect terrestrial habitats adjacent to the treatment area. Precautionary label statements will also be required to inform users that saflufenacil is toxic to non-target terrestrial plants.

Next Steps

Before making a final registration decision on saflufenacil, the PMRA will consider any comments received from the public in response to this consultation document. The PMRA will accept written comments on this proposal up to 45 days from the date of publication of this document. Please forward all comments to Publications (contact information on the cover page of this document). The PMRA will then publish a Registration Decision, which will include its decision, the reasons for it, a summary of comments received on the proposed final decision and the Agency's response to these comments.

Other Information

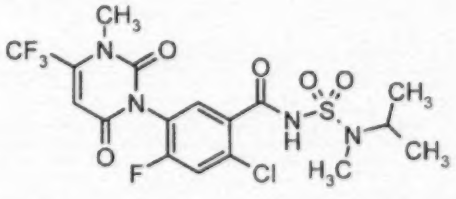
When the PMRA makes its registration decision, it will publish a Registration Decision on saflufenacil (based on the Science Evaluation section of this consultation document). In addition, the test data referenced in this consultation document will be available for public inspection, upon application, in the PMRA's Reading Room (located in Ottawa).

Science Evaluation

Saflufenacil

1.0 The Active Ingredient, Its Properties and Uses

1.1 Identity of the Active Ingredient

Active substance	Saflufenacil
Function	Herbicide
Chemical name	
1. International Union of Pure and Applied Chemistry (IUPAC)	2-chloro-4-fluoro-5-[3-methyl-2,6-dioxo-4-(trifluoromethyl)-3,6-dihydropyrimidin-1(2*H*)-yl]-*N*-[methyl(propan-2-yl)sulfamoyl]benzamide
2. Chemical Abstracts Service (CAS)	2-chloro-5-[3,6-dihydro-3-methyl-2,6-dioxo-4-(trifluoromethyl)-1(2*H*)-pyrimidinyl]-4-fluoro-*N*-[[methyl(1-methylethyl)amino]sulfonyl]benzamide
CAS number	372137-35-4
Molecular formula	$C_{17}H_{17}ClF_4N_4O_5S$
Molecular weight	500.86
Structural formula	
Purity of the active ingredient	97.4% nominal

1.2 Physical and Chemical Properties of the Active Ingredient and End-Use Product

Technical Product—Kixor

Property	Result
Colour and physical state	White solid
Odour	Odourless
Melting range	189.9°C with a peak maximum of 193.4°C by differential scanning calorimetry
Boiling point or range	Solid at room temperature
Density	1.595 g/cm^3
Vapour pressure at 20°C	4.5×10^{-15} Pa (extrapolated)

Property	Result		
Ultraviolet (UV)-visible spectrum	pH	λ_{max} (nm)	ε (L/mol•cm)
	1.12 (acidic)	271.8	9539
	6.94 (neutral)	271.4	9708
	11.69 (basic)	309.4	2358
Solubility in water at 20°C	pH	Solubility (g/100 mL)	
	4 (buffer)	0.0014	
	5 (buffer)	0.0025	
	7 (buffer)	0.21	
	9 (buffer)	could not be determined due to degradation	
Solubility in organic solvents at 20°C	Solvent	Solubility (g/100 mL)	
	N,N-Dimethylformamide	55.4	
	Tetrahydrofuran	36.2	
	Butyrolactone	35.0	
	Acetone	27.5	
	Dichloromethane	24.4	
	Acetonitrile	19.4	
	Ethyl acetate	6.55	
	Methanol	2.98	
	Isopropyl alcohol	0.25	
	Toluene	0.23	
	Olive oil	0.01	
	1-Octanol	< 0.01	
	n-Heptane	< 0.005	
n-Octanol-water partition coefficient (K_{ow})	K_{ow}	log K_{ow}	
	368.3	2.6	
Dissociation constant (pK_a)	pK_a = 4.41 ± 0.025		
Stability (temperature, metal)	Test substance was stable at room temperature and 54°C for two weeks alone, and when put in contact with Fe, Al and the corresponding acetate salts.		

End-Use Product—Detail

Property	Result
Colour	White
Odour	Faint fruity
Physical state	Liquid
Formulation type	Suspension
Guarantee	342 g/L
Container material and description	High density polyethylene (HDPE) bottles with induction or foam sealed caps
Density	1.150 g/cm^3
pH of 1% dispersion in water	4.7
Oxidizing or reducing action	Reacts moderately with oxidizing agents (moderate exothermic reaction of ≤5°C/g on contact with potassium permanganate), so that it is considered a mild reducing agent. Does not react with iron (a reducing agent), water or monoammonium phosphate (a fire-extinguishing agent).

Property	Result
Storage stability	A.I. content was stable after storage at 54°C for 2 weeks in HDPE. A.I. content was stable after storage at 23°C for 2 years, with measurements at the start and finish as well as five incremental measurements.
Corrosion characteristics	HDPE packaging showed no adverse effects after storage at 23°C for 2 years.
Explodability	As a water-based formulation, the product is not expected to be explosive.

1.3 Directions for Use

Detail is intended for application to control emerged broadleaved weeds at a rate of 145-290 mL/ha (equivalent to 50-100 g a.i./ha) with the higher rate recommended for heavy weed infestations and/or larger weeds. A maximum rate of 435 mL/ha (150 g a.i./ha) may be used for control of emerged weeds as well as residual pre-emergence control of particular weeds. Detail Herbicide is applied in combination with 0.5% v/v Merge Adjuvant or Hasten NT Spray Adjuvant using ground application equipment in a minimum spray volume of 200 L water/ha.

For control of a broader spectrum of weeds, Detail may be applied in a tank mix with Arsenal PowerLine Herbicide at the registered rate of 3 L/ha (720 g a.i./ha) or a glyphosate herbicide (present as the isopropylamine, potassium, diammonium, or dimethylamine salt) at registered rates from 810 to 4320 g a.e./ha.

1.4 Mode of Action

Saflufenacil, belonging to the pyrimidindione chemical class, is an inhibitor of protoporphyrinogen IX oxidase (Protox), an enzyme of chlorophyll and heme biosynthesis. The inhibition of Protox in the presence of light results in the peroxidation of foliar cell membrane lipids, with subsequent cell membrane destruction. The herbicidal effects cause yellowing and browning of tissue and eventually death of susceptible plants. Saflufenacil is primarily a contact herbicide, but which also shows some residual activity when applied at the highest rate.

Saflufenacil is classified as a Group 14 herbicide by the Weed Science Society of America (WSSA) and as a Group E herbicide by the Herbicide Resistance Action Committee.

2.0 Methods of Analysis

2.1 Methods for Analysis of the Active Ingredient

Please refer to PRD 2009-18, *Saflufenacil*.

2.2 Method for Formulation Analysis

The method provided for the analysis of the active ingredient in the formulation has been validated and assessed to be acceptable for use as an enforcement analytical method.

3.0 Impact on Human and Animal Health

3.1 Toxicology Summary

A detailed review of the toxicological database for saflufenacil was conducted previously and is summarized in the PRD2009-18, *Saflufenacil*. The database is complete, consisting of the full array of toxicity studies currently required for hazard assessment purposes. Overall, the studies were carried out in accordance with currently accepted international testing protocols and Good Laboratory Practices. The scientific quality of the data is high and the database is considered adequate to define the majority of the toxic effects that may result from exposure to saflufenacil.

Detail, containing saflufenacil, was of low acute toxicity by the oral, dermal, and inhalation routes of exposure. It was minimally irritating to the eyes and skin. The formulation was not a dermal sensitizer in guinea pigs (Maximization Test).

Results of the toxicology studies conducted on laboratory animals with saflufenacil, as well as the toxicology endpoints for use in human health risk assessment, and an overall summary of the data can be found in PRD2009-18, *Saflufenacil*.

Incident Reports

Since 26 April 2007, registrants have been required by law to report incidents, including adverse effects to health and the environment, to the PMRA within a set time frame. In addition, the general public, medical community, government and non-governmental organizations are able to report pesticide incidents directly to the PMRA. As of 28 October 2016, the PMRA has received seven incident reports that occurred in Canada. Two incidents related to packaging failure (leaks), with no human injury reported. Two environmental incidents and one human incident were considered minor, there was one report with animal deaths that was considered unlikely to have been caused by exposure to a saflufenacil-containing product (Heat LQ) and the final report was a scientific study (environmental toxicity) that was considered unlikely to affect the current risk characterization of the product.

In the human incident, minor skin redness was reported after a product containing saflufenacil splashed onto the forearm during application activities. In the domestic animal incident, several horses and cows died after ingesting treated hay feed. The feed was treated with a product containing saflufenacil two years prior to exposure. The effects described in animals included blindness, abortion, open sores, hair loss and death. The likelihood of exposure to saflufenacil was considered to be low, given the time the animals were exposed i.e. two years after the treated hay was baled. Also, there was a lack of consistency with the observed effects in toxicity studies conducted with saflufenacil. Therefore, it was determined that the incident was to be unlikely to be related to the pesticide. The incident report information was incorporated into the evaluation of saflufenacil and did not impact the risk assessment.

3.2 Occupational and Residential Risk Assessment

3.2.1 Toxicological Endpoints

Occupational exposure to Detail is characterized as short- to intermediate-term for commercial applicators and short-term duration for workers entering treated sites. Exposure to saflufenacil is expected to be mainly via the dermal and inhalation routes for mixing, loading, and application, and through the dermal route for postapplication re-entry workers and for the public entering treated sites.

3.2.1.1 Dermal Absorption

Considering the dermal absorption study was conducted with a liquid formulation and the Detail formulation is similar to Heat LQ and Eragon LQ, the dermal absorption value of 50%, as presented in PRD2009-18, *Saflufenacil*, is considered acceptable for the assessment of Detail.

3.2.2 Occupational Exposure and Risk

3.2.2.1 Mixer/loader/applicator Exposure and Risk Assessment

Individuals have potential for exposure to Detail during mixing, loading, and application. Dermal and inhalation exposure estimates of workers were generated using the Pesticide Handlers Exposure Database (PHED v.1.1, 2002).

Exposure estimates were derived for mixers, loaders, and applicators applying Detail to non-croplands using backpack, right-of-way, and groundboom sprayers. The exposure estimates are based on workers wearing coveralls over a long-sleeved shirt and long pants, chemical-resistant gloves, and shoes plus socks during mixing, loading, applying, clean-up and repair.

Chemical-specific data for assessing human exposures during pesticide handling activities were not submitted.

Dermal exposure was estimated by coupling the unit exposure values from the PHED database with the amount of product handled per day and the dermal absorption value of 50%. Inhalation exposure was estimated by coupling the unit exposure value with the amount of product handled per day with 100% inhalation absorption. Exposure was normalized to mg/kg bw/day by using 80 kg adult body weight.

Dermal and inhalation exposure estimates were compared to the oral toxicological endpoint (no observed adverse effects level) to obtain the margin of exposure (MOE); the target MOE is 300 for dermal and inhalation routes.

Table 3.2.2.1.1 Mixer/Loader/Applicator PHED Unit Exposures

PHED Scenario		Unit Exposure (µg/kg a.i. handled)		Personal Protective Equipment
		Dermal Total	Inhalation [a]	
A	M/L Liquid, open pour	32.77	1.6	coveralls + single layer + gloves
B	M/L Liquid, closed	9.61	0.11	coveralls + single layer + gloves
C	Applicator, open cab groundboom	21.04	0.96	coveralls + single layer + gloves
D	Applicator, closed cab groundboom	11.05	0.06	single layer, (no) gloves
E	Applicator, Right-of-Way sprayer	524.04	5	coveralls + single layer + gloves
F	M/L/A backpack	2597.09	62.1	coveralls + single layer + gloves

Note: gloves are chemical-resistant; M = mixer, L = loader, A = applicator

a. Light inhalation; except moderate inhalation rate used for backpack

Table 3.2.2.1.2 M/L/A Exposure and Risk Estimates for Use of Detail (containing Saflufenacil) in Non-cropland Areas

PPE Scenario	Area Treated per Day (ha/day)	Amount of ai handled per day[1] (kg a.i./day)	PHED Unit Exposure (dermal) (µg/kg a.i. handled)	Dermal Exposure[2] (mg/kg bw/day)	PHED Unit Exposure (Inhalation) (µg/kg a.i. handled)	Inhalation Exposure[2] (mg/kg bw/day)	Combined MOE[3]
Groundboom							
A + C	360	54	54.3	0.01833	2.56	0.001728	**249**
A + D	360	54	43.82	0.01479	1.66	0.001121	314
B + C	360	54	31.14	0.01051	1.07	0.000722	445
Right-of-Way sprayer							
A + E	19[b]	2.85	556.81	0.00992	6.6	0.000235	492
Backpack							
F	0.75[c]	0.1125	2597.09	0.00183	62.1 [d]	0.000087	2613

Note: **Bolded** MOEs do not meet the target of 300

1. Amount of a.i. handled per day calculated using the maximum application rate of 150g a.i./ha × ATPD;
2. Exposure (dermal or inhalation) = amount of a.i. handled per day × unit exposure value × absorption × 0.001mg/µg / body weight (80kg)
   Where, Absorption = 50% dermal absorption; 100% inhalation systemic absorption is assumed;
3. Margin of Exposure (MOE) = NOAEL / Exposure
   Where, NOAEL = oral endpoint of 5 mg/kg bw/day; target MOE = 300

a. 3800L/day default volume per day ÷ (min. 200L spray volume/ha);
b. 150L/day default volume per day ÷ (min. 200L spray volume/ha).

There are no risks of concern for mixers, loaders, and applicators when label directions are followed which include engineering controls, such as, using an open-cab groundboom sprayer with a closed mixing and loading system; or, an open mixing and loading system with a closed cab groundboom sprayer.

3.2.2.2 Exposure and Risk Assessment for Workers Entering Treated Areas

There is potential for exposure to workers re-entering areas treated with Detail, primarily for scouting after a weed post-emergence application. The duration of exposure is considered to be short-term and the primary route of exposure for workers re-entering treated areas would be through the dermal route. Postapplication exposures to areas which have soil-directed treatments, for pre-emergence control of weeds, are not typically assessed as there is minimal exposure to the treated ground. Inhalation exposure is not of concern, as saflufenacil is not a volatile compound.

Occupational postapplication scouting in non-cropland areas are not expected to be as intense as in agricultural crops. Four hours of scouting was considered adequate in the re-evaluation of 2,4-D (PACR2007-06) and is used in the present risk assessment. The default exposure duration of 8 hours is retained for military bases, where full-day exposure may take place. No information was provided to estimate exposure to military personnel engaged in training exercises; therefore, the TC for scouting was used as a surrogate.

Dermal exposure to workers entering treated areas is estimated by coupling dislodgeable foliar residue values with activity-specific transfer coefficients (TC). Transfer coefficients are based on the Agricultural Reentry Task Force (ARTF) database. Chemical-specific dislodgeable foliar residue data were not submitted. Therefore, a default dislodgeable foliar residue value of 25% of the application rate was used in the exposure assessment. No dissipation was assumed for workers entering non-military sites on the day of application, but the default daily dissipation rate of 10% was required to estimate the restricted-entry interval (REI) for military base uses. The dermal exposure estimate was compared to the oral toxicological endpoint adjusted for dermal absorption to obtain the margin of exposure (MOE).

3.2.2.2.1 Postapplication re-entry exposure and risk estimates for industrial vegetation control in non-cropland sites treated with Detail

Dislodgeable foliar residue (µg/cm²)	Activity	Transfer Coefficient (cm²/h)[a]	Exposure Time (h)	Dermal Exposure[b] (mg/kg bw/day)	MOE[c] (target = 300)	Restricted-entry interval (days)
Non-Cropland: post-emergence (annual and perennial weeds)—fence rows, roadsides, rights-of-way, powerlines, railroads, industrial sites, airports, military bases, and other non-cropland areas						
0.375	Scouting	1100	4	0.0103	485	0
			8	0.0206	**242**	2

Note: **Bolded** MOEs do not meet the target of 300

a. No available for re-entry into treated non-cropland vegetation. The TC is considered as scouting of forage crops (ARTF, Transfer Coefficients, 2008, updated 2015). This scenario is expected to be representative of a person walking or scouting within non-cropland areas;

b. Dermal Exposure (mg/kg bw/day) = Dislodgeable Foliar Residue × Transfer Coefficient × Exposure Time × Dermal Absorption / Body Weight

Where, Dislodgeable foliar residue = maximum application rate (1.50µg/cm²) × 25%; no dissipation assumed on the day of application, but subsequent 10% daily dissipation required for calculation of REI for military base sites;
Transfer coefficient (cm²/h), from ARTF database for scouting forage crops (ARTF, 2008; Updated 2015) used as a surrogate for non-cropland sites;
Exposure time (h), 4 hours for non-military sites; 8 hours for military sites;
Dermal absorption (%), 50%;
Body Weight (kg), adult body weight (80kg)

c. Margin of Exposure (MOE) = NOAEL / Exposure

Where, NOAEL = oral endpoint of 5 mg/kg bw/day; target MOE = 300

Risks are not a concern for workers entering treated non-cropland sites on the day of application. Therefore, the proposed restricted-entry interval of 'Do not enter or allow others to enter treated areas until sprays have dried' is considered adequate for re-entry into treated non-military sites. Risks are not a concern for military personnel entering treated military base sites after a restricted-entry interval of 2 days.

3.2.3 Residential Exposure and Risk Assessment

No residential treatments will be applied; therefore, no risk assessments are required.

3.2.4 Bystander Exposure and Risk

There is potential for short-term exposure to saflufenacil for adults, youth (11<16 years old) and children (6<11 years old) by entry into treated non-cropland areas (for example, hiking along roadsides and rights-of-way that have recently been treated). Calculated dermal MOEs for bystander exposure to saflufenacil exceeded target MOEs and are not of concern. Bystander exposure is presented in Table 3.2.4.1. Applications are limited to non-cropland areas only, and drift is minimized by standard drift mitigation statements on the label.

Table 3.2.4.1 Bystander postapplication re-entry exposure and risk estimates for industrial vegetation control in non-cropland sites treated with Detail

Dislodgeable foliar residue ($\mu g/cm^2$)	Activity	Sub-population	Transfer Coefficient (cm^2/h)[a]	Dermal Exposure[b] (mg/kg bw/day)	MOE[c] (target = 300)
Non-Cropland: post-emergence (annual and perennial weeds)—fence rows, roadsides, rights-of-ways, powerlines, railroads, industrial sites, military bases, airports, and other non-cropland areas					
0.375	Hiking	Adult (16+ yrs old)	580	0.0027	1839
		Youth (11<16 yrs old)	476	0.0031	1597
		Child (6<11 yrs old)	319	0.0037	1338

a. No transfer coefficient (TC) available for re-entry into treated non-cropland vegetation. The surrogate TC used is scouting of orchard crops and forestry in the ARTF database (ARTF, Transfer Coefficients, 2008, updated 2015). This scenario is expected to be representative of a person walking or scouting within non-cropland areas.

b. Dermal Exposure (mg/kg bw/day) = Dislodgeable Foliar Residue × Transfer Coefficient × Exposure Time × Dermal Absorption / Body Weight

Where, Dislodgeable foliar residue, on day of application = maximum application rate (1.50 $\mu g/cm^2$) × 25%;
Transfer coefficient (cm^2/h), from ARTF database for scouting orchards and forestry (ARTF, Transfer Coefficients, 2008, updated 2015); Transfer coefficient of 580 cm^2/h based on a body weight of 80 kg were scaled for the surface area of youth and child (6 < 11 years old) using an adjustment factor of 0.82 and 0.55 respectively.
Exposure time (h) is 2 hours for all populations (US EPA, Exposure Factors Handbook, 2011)
Dermal absorption (%), 50%
Body Weight (kg), adult body (80 kg); youth (57 kg); and child (6 to <11 years old) (32 kg).

c. Margin of Exposure (MOE) = NOAEL / Exposure

Where, NOAEL = oral endpoint of 5 mg/kg bw/day; target MOE = 300

Risks are not a concern for bystanders entering treated non-cropland sites on the day of application.

3.3 Dietary Exposure Assessment

3.3.1 Residues in Plant and Animal Foodstuffs

Please refer to PRD2009-18, *Saflufenacil* for previously reviewed data. The information reviewed in this document relates to the changes in dietary risk assessment due to the modification in the drinking water assessments based on the registration of saflufenacil for use on non-cropland uses in Canada.

3.3.2 Concentrations in Drinking Water

3.3.2.1 Application Information and Model Inputs

Estimated environmental concentrations (EECs) of saflufenacil in potential drinking water sources (groundwater and surface water) were generated using the Pesticides in Water Calculator (PWC). EECs of saflufenacil in groundwater were calculated using PWC to simulate leaching through a layered soil profile over a 50-year period. The concentrations calculated using PWC

are average concentrations in the top 1m of the water table. EECs of saflufenacil in surface water were calculated by using the PWC model to simulate pesticide runoff from a treated field into an adjacent water body and the fate of a pesticide within that water body. Pesticide concentrations in surface water were estimated in a vulnerable drinking water source, a small reservoir. For both surface water and groundwater, a single application of 150 g a.i./ha was modelled. A set of initial application dates from April through June were modelled, and the highest concentration used for risk assessment. Important environmental fate parameters used for modelling are shown in Table 3.3.2.1.1.

There are several transformation products of saflufenacil, and four products were included in the drinking water modelling. These four transformation products are M800H01, M800H02, M800H07, and M800H08, which are designated herein as M01, M02, M07 and M08. In the current assessment, a combined residue of the parent and the above four transformation products was modelled for drinking water. Thus environmental half lives in soil and water were calculated for the combined residues of saflufenacil, M01, M02, M07 and M08.

Table 3.3.2.1.1 Major groundwater and surface water model inputs for Level 1 assessment of combined residues

Type of Input	Parameter	Value
Application Information	Maximum allowable application rate per year (g a.i./ha)	150
	Maximum rate each application (g a.i./ha)	150
	Maximum number of applications per year	1
	Minimum interval between applications (days)	NA
	Method of application	Ground
Environmental Fate Characteristics	Hydrolysis half-life at pH 7 (days)	Stable
	Photolysis half-life in water (days)	11
	Adsorption K_{oc} (ml/g)	6.6 (20^{th} percentile of K_{oc} values for Saflufenacil + M01 + M02 + M07 + M08)
	Aerobic soil biotransformation half-life (days)	3470 (maximum of three half-lives available)
	Aerobic aquatic biotransformation half-life (days)	404 (the value for the dark system)
	Anaerobic aquatic biotransformation half-life (days)	1900 (the value for the entire system)

A Level 1 drinking water assessment was conducted using conservative assumptions with respect to application rate and timing, and geographic scenario. Table 3.3.2.1.2 below provides the Level 1 EECs for potential sources of drinking water. These results are valid for 150 g a.i./ha application rate for the early application and 50 g a.i./ha application rate for the late application. This EEC estimate should therefore allow for future use expansion into other crops at these application rates and their corresponding application seasons (at the higher rate of 150 g a.i./ha during April-June only).

Table 3.3.2.1.2 Level 1 estimated environmental concentrations of saflufenacil combined residues in potential drinking water sources

Compound	Groundwater EEC (µg a.i./L)		Surface Water EEC (µg a.i./L)	
	Daily[1]	Yearly[2]	Daily[3]	Yearly[4]
Saflufenacil + M01 + M02 + M07 + M08	323	323	13	1.9

[1] 90th percentile of daily average concentrations
[2] 90th percentile of yearly average concentrations
[3] 90th percentile of yearly peak concentrations
[4] 90th percentile of yearly average concentrations

3.3.3 Dietary Risk Assessment

Acute and chronic non-cancer dietary risk assessments were conducted using the Dietary Exposure Evaluation Model (DEEM–FCID™).

3.3.3.1 Acute Dietary Exposure Results and Characterization

Aggregate exposure from food and drinking water is considered acceptable: 100% of the ARfD for females 13–49 years old and <2% of the ARfD for all other subpopulations.

3.3.3.2 Chronic Dietary Exposure Results and Characterization

Aggregate exposure from food and drinking water is considered acceptable. The PMRA estimates that chronic dietary exposure to saflufenacil from food and drinking water is 16% (0.00776 mg/kg bw/day) of the ADI for all subpopulations (excluding females 13-49 years of age) and 41% (0.00695 mg/kg bw/day) of the ADI for females 13-49 years of age. The highest exposure and risk estimate is for all infants (< 1 year) at 51% (0.0240 mg/kg bw/day) of the ADI.

3.3.4 Aggregate Exposure and Risk

The aggregate risk for saflufenacil consists of exposure from food and drinking water sources only; there are no residential uses.

3.3.5 Maximum Residue Limits

Please refer to the Maximum Residue Limit Database for all currently specified saflufenacil MRLs. The nature of the residues in animal and plant matrices, analytical methodology and residue trial data were assessed under PRD2009-18, *Saflufenacil*. The chronic dietary risk estimates are summarized in Table 1, Appendix I.

4.0 Impact on the Environment

4.1 Fate and Behaviour in the Environment

The fate and environmental behaviour of saflufenacil have been previously assessed for foliar application on agricultural crops (for further details see Proposed Regulatory Decision PRD2009-18 and Regulatory Decision RD2010-05).

4.2 Environmental Risk Characterization

The environmental risk assessment integrates the environmental exposure and ecotoxicology information to estimate the potential for adverse effects on non-target species. This integration is achieved by comparing exposure concentrations with concentrations at which adverse effects occur. Estimated environmental exposure concentrations (EECs) are concentrations of pesticide in various environmental media, such as food, water, soil and air. The EECs are estimated using standard models which take into consideration the application rate(s), chemical properties and environmental fate properties, including the dissipation of the pesticide between applications. Ecotoxicology information includes acute and chronic toxicity data for various organisms or groups of organisms from both terrestrial and aquatic habitats including invertebrates, vertebrates, and plants. Toxicity endpoints used in risk assessments may be adjusted to account for potential differences in species sensitivity as well as varying protection goals (i.e. protection at the community, population, or individual level).

Initially, a screening level risk assessment is performed to identify pesticides and/or specific uses that do not pose a risk to non-target organisms, and to identify those groups of organisms for which there may be a potential risk. The screening level risk assessment uses simple methods, conservative exposure scenarios (for example, direct application at a maximum cumulative application rate) and sensitive toxicity endpoints. A risk quotient (RQ) is calculated by dividing the exposure estimate by an appropriate toxicity value (RQ = exposure/toxicity), and the risk quotient is then compared to the level of concern (LOC). If the screening level risk quotient is below the level of concern, the risk is considered negligible and no further risk characterization is necessary. If the screening level risk quotient is equal to or greater than the level of concern, then a refined risk assessment is performed to further characterize the risk. A refined assessment takes into consideration more realistic exposure scenarios (such as drift to non-target habitats) and might consider different toxicity endpoints. Refinements may include further characterization of risk based on exposure modelling, monitoring data, results from field or mesocosm studies, and probabilistic risk assessment methods. Refinements to the risk assessment may continue until the risk is adequately characterized or no further refinements are possible.

The environmental toxicity and risk assessment of saflufenacil had been previously characterized for foliar uses on agricultural crops at rates of application up to 100 g a.i./ha (see Proposed Regulatory Decision PRD2009-18, *Saflufenacil*, and Regulatory Decision RD2010-05).

As the proposed label for the herbicide end-use product, Detail, indicates a higher application rate than previously registered, the risk to non-target terrestrial and aquatic organisms was re-assessed. A summary of the risk assessment is presented in Appendix I, Tables 3-5 (see PRD2009-18, *Saflufenacil*, for the toxicity data).

4.2.1 Risks to Terrestrial Organisms

Saflufenacil is toxic to terrestrial vascular plants. Based on an EEC equal to the maximum application rate for the proposed uses (150 g a.i./ha), and a toxicity endpoint for effects on seedling emergence (HR_5 of species sensitivity distribution of ER_{50} values = 0.22 g a.i./ha), the calculated risk quotient exceeds the level of concern at the screening level (RQ=681). The risk to terrestrial vascular plants was further characterized by looking at off-field exposure from drift.

For an ASAE 'medium' droplet size, the maximum spray drift deposition at one meter downwind from the point of application is 6% for ground application. The maximum percent deposition on non-target plants located 1 metre downwind from the point of application would therefore be 9 a.i./ha (150 g a.i./ha × 0.06). Based on the risk quotients using the off-field EECs from drift, the level of concern for terrestrial vascular plants is still exceeded (RQ = 41). Mitigation measures including no spray buffer zones will be required to protect terrestrial habitats adjacent to the treatment area.

The calculated risk quotient marginally exceeds the level of concern at the screening level for terrestrial plants (RQ=1.8) for the soil transformation product, M800H08. It did not, however, exceed the level of concern for off-field exposure from drift. There are no concerns about the major soil transformation product M800H07 affecting non-target terrestrial plants (see Appendix I, Table 4).

The LOC for the screening level risk assessment for birds was slightly exceeded for the reproductive endpoint used for small and medium sized birds (RQ < 2). The end-point used in this screening level risk assessment (NOEL= 7.3 mg a.i./kg bw/day) was a very conservative estimate of the risk to birds, since the lowest observed effect level was 20.7 mg a.i./kg bw/day.

To further characterize this risk, diet composition, potential residue levels in food items, and on-field versus off-field exposure may be considered. A bird would need to consume their entire diet from contaminated food items within the treated area at maximum predicted residue levels to exceed the LOC. It is likely that potential residues in food items adjacent to the treated area will be less and that on-field levels could be closer to predicted mean residue levels. It is also unlikely that a bird will take their entire diet from on-field. In addition, only one application per season is proposed. Therefore, it is expected that, taking this information into consideration, RQs would not exceed the LOC for an off-field assessment and would be lower (for example, not at maximum residue levels and through dissipation over time) for the on-field assessment. Thus, based on further characterization, the herbicide end-use product, Detail, is not expected to pose a reproductive risk to birds.

The LOCs for earthworms and bees were not exceeded. Therefore, based on the available information, saflufenacil and its transformation products are not expected to pose a risk of concern to earthworms, bees, birds and mammals as the level of concern was not exceeded (Appendix I, Table 4). Saflufenacil is expected to pose a risk to terrestrial plants, whereas its transformation products will not; mitigation measures will be required.

4.2.2 Risks to Aquatic Organisms

Saflufenacil was shown to be practically non-toxic to fish and freshwater invertebrates on an acute basis. Chronic exposure to saflufenacil reduced survival in fathead minnow, daphnia and chironomids. Saflufenacil and its transformation products M800H07 and M800H08 showed adverse effects on growth rate, biomass and frond number in algae, diatoms and duckweed. Saflufenacil and its transformation product M800H08 showed adverse effects on survival in marine shrimp and diatom.

Assuming direct application of 150 g saflufenacil/ha to aquatic habitat, the screening level risk quotient values were less than the level of concern for all aquatic organisms. Saflufenacil and its transformation products are not expected to pose a risk of concern to non-target aquatic organisms as the level of concern was not exceeded (Appendix I, Table 5).

4.2.3 Incident Reports

Environmental incident reports are obtained from two main sources, the Canadian pesticide incident reporting system (including both mandatory reporting from the registrant and voluntary reporting from the public and other government departments) and the USEPA Ecological Incident Information System (EIIS). Specific information regarding the mandatory reporting system regulations that came into force 26 April 2007 under the *Pest Control Products Act* can be found at http://www.hc-sc.gc.ca/cps-spc/pest/part/protect-proteger/incident/index-eng.php.

As of 10 January 2017, the PMRA has received two environmental incidents involving the active ingredient saflufenacil. The two environmental incidents were classified as minor. In both incidents, trees and/or plants were affected as a result of drift from application of a pesticide containing saflufenacil. The incidents involved willow trees, evergreens, onions and carrots.

The USEPA's Ecological Incident Information System (EIIS) was also queried for environmental incidents. There were three incident reports available in the EIIS database. One incident was considered possibly related to the reported pesticide. In this incident, soybean plants were affected after a product containing saflufenacil was applied to a field. No other details were available.

The incident report data was incorporated into the evaluation of the active ingredient saflufenacil.

5.0 Value

5.1 Consideration of Benefits

Detail will serve as an alternate broadleaf weed control option in non-cropland areas. As Detail is applied to emerged broadleaf weeds, its suitability for the weed spectrum that is present can be assessed prior to application. As the highest application rate can be expected to provide residual control of several weeds, its use may reduce the total number of herbicide applications needed to maintain control throughout the season.

Currently, herbicides belonging to WSSA mode-of-action groups 2, 4, 5, 7, 9, 11, 14 and 20 are registered for application to non-cropland areas. Detail will be the first Group 14 herbicide that is intended for application to emerged weeds and can be expected to control populations of labelled weeds that have developed resistance to group 2 or group 9 herbicides. The application of Detail in tank mixtures with either Arsenal Powerline Herbicide or a glyphosate herbicide can be expected to reduce the potential for the development of herbicide resistance as well as broaden the spectrum of weeds controlled, including grass weeds and woody species.

5.2 Effectiveness Against Pests

Applied at 145-290 mL/ha (50-100 g a.i./ha), Detail will provide post-emergence control or suppression of emerged weed species listed in Appendix I, Table 2. When the application rate is increased to 435 mL/ha (150 g a.i./ha), Detail will not only control emerged weeds, but will also provide residual pre-emergence control of the weeds listed in Appendix I, Table 2.

The consistency of control of certain weed species can be increased by tank mixing Detail with Arsenal Powerline Herbicide. This tank mix also allows for control of a broader spectrum of weeds. Similarly, tank mixing Detail with glyphosate also broadens the spectrum of weeds controlled.

Consideration of efficacy data that were generated under Research Authorizations, data that were previously submitted for other saflufenacil products, information from published reports, and use history information collectively support the claims summarized in Appendix I, Table 2.

5.3 Non-Safety Adverse Effects

This section is not applicable as Detail is only for application to non-cropland areas.

5.4 Supported Uses

The available value information support claims of control, suppression or top-growth control, with the particular claim being specific to broadleaf weed species or growth stage, for Detail applied at the rate of 145-290 ml/ha in combination with 0.5% v/v Merge Adjuvant or Hasten NT Spray Adjuvant when weeds are less than 15 cm. Detail may be applied at 435 mL/ha with either adjuvant at 0.5% v/v for residual control of particular weeds.

6.0 Pest Control Product Policy Considerations

6.1 Toxic Substances Management Policy Considerations

The Toxic Substances Management Policy (TSMP) is a federal government policy developed to provide direction on the management of substances of concern that are released into the environment. The TSMP calls for the virtual elimination of Track 1 substances [those that meet all four criteria outlined in the policy, in other words, persistent (in air, soil, water and/or sediment), bio-accumulative, primarily a result of human activity and toxic as defined by the *Canadian Environmental Protection Act*].

During the review process, saflufenacil and its transformation products were assessed in accordance with the PMRA Regulatory Directive DIR99-03[5] and evaluated against the Track 1 criteria. The PMRA has reached the following conclusions:

- Saflufenacil does not meet Track 1 criteria, and is not considered a Track 1 substance. Please refer to PRD2009-18 for details.

6.2 Formulants and Contaminants of Health or Environmental Concern

During the review process, contaminants in the technical and formulants and contaminants in the end-use products are compared against the *List of Pest control Product Formulants and Contaminants of Health or Environmental Concern* maintained in the *Canada Gazette*.[6] The list is used as described in the PMRA Notice of Intent NOI2005-01[7] and is based on existing policies and regulations including: DIR99-03; and DIR2006-02,[8],and taking into consideration the Ozone-depleting Substance Regulations, 1998, of the *Canadian Environmental Protection Act* (substances designated under the Montreal Protocol). The PMRA has reached the following conclusions:

- Technical-grade Kixor and the associated herbicide end-use product Detail do not contain any formulants or contaminants of health or environmental concern identified in the *Canada Gazette*.

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5 DIR99-03, *The Pest Management Regulatory Agency's Strategy for Implementing the Toxic Substances Management Policy*

6 *Canada Gazette*, Part II, Volume 139, Number 24, SI/2005-114 (2005-11-30) pages 2641–2643: *List of Pest Control Product Formulants and Contaminants of Health or Environmental Concern* and in the order amending this list in the *Canada Gazette*, Part II, Volume 142, Number 13, SI/2008-67 (2008-06-25) pages 1611-1613. *Part 1 Formulants of Health or Environmental Concern, Part 2 Formulants of Health or Environmental Concern that are Allergens Known to Cause Anaphylactic-Type Reactions and Part 3 Contaminants of Health or Environmental Concern.*

7 NOI2005-01, *List of Pest Control Product Formulants and Contaminants of Health or Environmental Concern under the New Pest Control Products Act.*

8 DIR2006-02, *Formulants Policy and Implementation Guidance Document.*

- The use of formulants in registered pest control products is assessed on an ongoing basis through PMRA formulant initiatives and Regulatory Directive DIR2006-02.

7.0 Summary

7.1 Human Health and Safety

The toxicology database submitted for saflufenacil is adequate to define the majority of toxic effects that may result from exposure. In short- and long-term toxicity studies on laboratory animals, target organs included the blood, liver, spleen, and bone marrow. There was no evidence to support that saflufenacil was carcinogenic, genotoxic, neurotoxic, or induced reproductive toxicity. Increased susceptibility of the young to saflufenacil was demonstrated in the rat but not the rabbit developmental toxicity study.

Mixers, loaders, and applicators handling the herbicide end-use product, Detail, and workers re-entering treated non-cropland areas are not expected to be exposed to levels of saflufenacil that will result in unacceptable risks when used according to label directions. The personal protective equipment on the product label and other precautionary statements are adequate to protect workers.

Bystander exposure is not expected to result in unacceptable risk when the herbicide end-use product, Detail, is used according to label directions.

Please refer to PRD2009-18, *Saflufenacil* for previously reviewed food residue chemistry data. The use of saflufenacil in/on non-cropland areas does not constitute a dietary risk of concern for acute or chronic (non-cancer) dietary exposure (food and drinking water) to any segment of the population, including infants, children, adults and seniors.

7.2 Environmental Risk

The use of saflufenacil is not expected to pose risks of concern to earthworms, bees, birds, wild mammals, fish, amphibians, aquatic invertebrates, algae, or aquatic vascular plants. Risks to non-target terrestrial plants as a result of spray drift have been identified in areas adjacent to the treatment area. To mitigate risks from the use of saflufenacil (150 g a.i./ha) to non-target terrestrial plants, no-spray buffer zones of 20 m are required for sensitive terrestrial habitats downwind from the treatment area. When used according to label directions, saflufenacil is not expected to pose risks of concern to the environment.

7.3 Value

The value information submitted to register Detail for control or suppression of annual and perennial broadleaf weeds is adequate to demonstrate value, including efficacy for use in non-crop areas, such as rights-of-way, railway crossings and rail yards, roadsides, utility plant sites, petroleum tank farms, pumping installations, non-agricultural fencerows, military bases and airports.

There are currently other herbicides belonging to WSSA groups 2, 4, 5, 7, 9, 11, 14 and 20 that are registered for application to non-cropland areas. Detail is the only Group 14 herbicide that is intended for application to emerged weeds and will offer an alternative for broadleaved weed management in non-cropland areas. The application of Detail in tank mixtures or alternately with herbicides of differing modes of action can be expected to mitigate the potential for resistance development in susceptible broadleaved weed populations.

8.0 Proposed Regulatory Decision

Health Canada's Pest Management Regulatory Agency (PMRA), under the authority of the *Pest Control Products Act* and Regulations, is proposing full registration for the sale and use of saflufenacil technical, Kixor and the herbicide end-use product, Detail, containing the technical grade active ingredient saflufenacil, to control broadleaf weeds in non-crop areas.

An evaluation of available scientific information found that, under the approved conditions of use, the product has value and does not present an unacceptable risk to human health or the environment.

List of Abbreviations

µg	micrograms
1/n	exponent for the Freundlich isotherm
a.i.	active ingredient
ADI	acceptable daily intake
ALS	acetolactate synthase
ARfD	acute reference dose
atm	atmosphere
bw	body weight
CAS	Chemical Abstracts Service
cm	centimetres
DF	dry flowable
DNA	deoxyribonucleic acid
DT_{50}	dissipation time 50% (the dose required to observe a 50% decline in concentration)
DT_{90}	dissipation time 90% (the dose required to observe a 90% decline in concentration)
EC_{25}	effective concentration on 25% of the population
EC_{50}	effective concentration on 50% of the population
ER_{25}	effective rate for 25% of the population
g	gram
ha	hectare(s)
HDT	highest dose tested
Hg	mercury
HPLC	high performance liquid chromatography
IUPAC	International Union of Pure and Applied Chemistry
kg	kilogram
K_d	soil-water partition coefficient
K_F	Freundlich adsorption coefficient
km	kilometre
K_{oc}	organic-carbon partition coefficient
K_{ow}	*n*–octanol-water partition coefficient
L	litre
LC_{50}	lethal concentration 50%
LD_{50}	lethal dose 50%
LOAEL	lowest observed adverse effect level
LOEC	low observed effect concentration
LOQ	limit of quantitation
LR_{50}	lethal rate 50%
mg	milligram
mL	millilitre
MAS	maximum average score
MOE	margin of exposure
MRL	maximum residue limit
MS	mass spectrometry
N/A	not applicable

NOAEL	no observed adverse effect level
NOEC	no observed effect concentration
NOEL	no observed effect level
NOER	no observed effect rate
N/R	not required
NZW	New Zealand white
OC	organic carbon content
OM	organic matter content
PBI	plantback interval
PHI	preharvest interval
pK_a	dissociation constant
PMRA	Pest Management Regulatory Agency
ppm	parts per million
RSD	relative standard deviation
SC	soluble concentrate
$t_{1/2}$	half-life
T3	tri-iodothyronine
T4	thyroxine
TRR	total radioactive residue
TSMP	Toxic Substances Management Policy
UAN	urea ammonium nitrate
UF	uncertainty factor
USEPA	United States Environmental Protection Agency
UV	ultraviolet
v/v	volume per volume dilution

Appendix I Tables and Figures

Table 1 Dietary Risk Assessment

DIETARY RISK FROM FOOD AND WATER			
Refined acute dietary exposure analysis, 95th percentile **General population ARfD = 5.0 mg/kg bw** **Females 13-49 ARfD = 0.017 mg/kg bw** **Estimated acute drinking water concentration = 323 □g/L**	**POPULATION**	**ESTIMATED RISK % of ACUTE REFERENCE DOSE (ARfD)**	
		Food Alone	**Food and Water**
	All infants < 1 year	0.07	1.3
	Children 1–2 years	0.23	0.7
	Children 3 to 5 years	0.20	0.6
	Children 6–12 years	0.12	0.4
	Males 13–19 years	0.06	0.3
	Males 20–49 years	0.05	0.3
	Adults 50+ years	0.04	0.3
	Females 13-49 years	13.8	100
Refined chronic dietary exposure analysis **General population ADI = 0.046 mg/kg bw/day** **Females 13-49 ADI = 0.017 mg/kg bw/day** **Estimated chronic drinking water concentration = 323 □g/L**	**POPULATION**	**ESTIMATED RISK % of ACCEPTABLE DAILY INTAKE (ADI)**	
		Food Alone	**Food and Water**
	All infants < 1 year	2.3	51
	Children 1–2 years	6.7	29
	Children 3 to 5 years	6.0	26
	Children 6–12 years	3.3	18
	Males 13–19 years	1.8	13
	Males 20–49 years	1.6	15
	Adults 50+ years	1.5	16
	Females 13-49 years	3.6	41

Table 2 Accepted Label Claims

145-290 mL/ha in combination with 0.5% v/v Merge Adjuvant or Hasten NT Spray Adjuvant applied to emerged weeds <15 cm tall by ground application equipment for post-emergence control of: - field bindweed (control of seedling stage and suppression of perennial growth stage) - wild buckwheat - Canada fleabane - common chickweed - common cocklebur - cowcockle - dandelion (control of seedling stage and suppression of perennial growth stage) - hairy fleabane - flixweed - common groundsel - henbit (suppression) - prostrate knotweed - kochia, including group 2 and 9 resistant - lady's thumb - lamb's-quarters - prickly lettuce (top growth burn down control) - common mallow - entireleaf morningglory - ivyleaf morningglory - pitted morningglory - tall morningglory - tumble mustard - wild mustard - black nightshade - cutleaf nightshade - Eastern black nightshade - hairy nightshade - prostrate pigweed - redroot pigweed - smooth pigweed - common purslane - common ragweed - giant ragweed - volunteer rapeseed (canola) - shepherd's-purse - Pennsylvania smartweed - stinkweed - annual sowthistle - spiny sowthistle - perennial sowthistle (top growth burn down control) - common sunflower

- Canada thistle (control of seedling stage and suppression of perennial growth stage) - Russian thistle - velvetleaf
150 g a.i./ha (435 mL/ha) in combination with 0.5% v/v Merge Adjuvant or Hasten NT Spray Adjuvant applied in a minimum spray volume of 200 L/ha to emerged weeds <15 cm tall by ground application equipment only for post-emergence and residual pre-emergence control of: - wild buckwheat - Canada fleabane - common chickweed - common cocklebur - kochia, including group 2 and 9 resistant - lady's thumb - lamb's-quarters - entireleaf morningglory - ivyleaf morningglory - pitted morningglory - tall morningglory - wild mustard - black nightshade - prostrate pigweed - redroot pigweed - smooth pigweed - common purslane - common ragweed - giant ragweed - Pennsylvania smartweed - stinkweed - common sunflower - Russian thistle - velvetleaf
Tank mix of Detail at 50-100 g a.i./ha (145-290 mL/ha) or 150 g a.i./ha (435 mL/ha) plus 720 g a.i./ha (3.0 L/ha) Arsenal Powerline Herbicide plus 0.5% v/v Merge Adjuvant or Hasten NT Spray Adjuvant applied in a minimum spray volume of 200 L/ha by ground application equipment for broader spectrum residual weed control, including group 2 resistant weeds.
Tank mix of Detail at 50-100 g a.i./ha (145-290 mL/ha) or 150 g a.i./ha (435 mL/ha) plus a glyphosate herbicide (present as isopropylamine salt, potassium salt, diammonium salt or dimethylamine salt) at 810-4320 g a.e./ha (for example,1.5-8 L/ha of 540 g ae/L formulations or 1.69-9 L/ha of 480 g a.e./L formulations) without or with 0.5% v/v Merge Adjuvant or Hasten NT Spray Adjuvant (for improved control of larger weeds) applied in a minimum spray volume of 200 L/ha by ground application equipment for accelerated burndown of a broader spectrum of weeds, including control of a glyphosate-tolerant broadleaf weed species.

Table 3 Screening Level Risk Assessment for Birds and Mammals

Organism	Toxicity Endpoint (mg a.i./kg bw/d)	Feeding Guild (food item)	EDE[1] (mg a.i./kg bw[2])	RQ	Level of Concern[3] Exceeded?
Small Bird (0.02 kg)					
Acute	2000[A]	Insectivore	12.21	0.01	No
Reproduction	7.30	Insectivore	12.21	1.67	Yes
Medium Sized Bird (0.1 kg)					
Acute	2000	Insectivore	9.53	0.00	No
Reproduction	7.30	Insectivore	9.53	1.31	Yes
Large Sized Bird (1 kg)					
Acute	2000	Herbivore (short grass)	6.15	0.00	No
Reproduction	7.30	Herbivore (short grass)	6.15	0.84	
Small Mammal (0.015 kg)					
Acute	2000[A]	Insectivore	7.02	0.00	No
Reproduction	15.0	Insectivore	7.02	0.47	
Medium Sized Mammal (0.035 kg)					
Acute	2000	Herbivore (short grass)	13.62	0.01	No
Reproduction	15.0	Herbivore (short grass)	13.62	0.91	
Large Sized Mammal (1 kg)					
Acute	2000	Herbivore (short grass)	7.28	0.00	No
Reproduction	15.0	Herbivore (short grass)	7.28	0.49	

[1] EDE = Estimated dietary exposure; is calculated using the following formula: (FIR/bw) × EEC, where
FIR: Food Ingestion Rate. For generic birds with body weight less than or equal to 200 g, the "passerine" equation was used; for generic birds with body weight greater than 200 g, the "all birds" equation was used:
Passerine Equation (body weight ≤200 g): FIR (g dry weight/day) = $0.398(\text{bw in g})^{0.850}$
All birds Equation (body weight >200 g): FIR (g dry weight/day) = $0.648\ (\text{bw in g})^{0.651}$
For mammals, the "all mammals" equation was used: FIR (g dry weight/day) = $0.235(\text{bw in g})^{0.822}$
EEC: Concentration of pesticide on food item based on a single application of 150 g a.i./ha. At the screening level, relevant food items representing the most conservative EEC for each feeding guild are used.
[2] bw: Generic Body Weight
[3] Level of Concern (LOC) = 1 for birds and mammals
[A] No toxicity/effects were observed up to and including the highest dose tested for birds and mammals. The LD_{50} was, therefore, considered to be equivalent to a no-effect-level and the toxicity endpoint was not adjusted.

Table 4 Risk Assessment for Earthworms, Bees and Terrestrial Plants

Organism	Exposure	Substance	Toxicity Endpoint	EEC	Units	RQ	Level of Concern[1] Exceeded?
Earthworm	acute	saflufenacil	LC_{50}/2 >100	0.0666[A]	mg/kg dw	<0.01	No
		M800H08[3]	LC_{50}/2 >100	0.0666[A]	mg/kg dw	<0.01	
Bee	oral	BAS800 01H[2]	48h LD_{50} >121	4.35[B]	µg a.i./bee	<0.036	
	contact	saflufenacil	48h LD_{50} >100	0.36[C]	µg a.i./bee	<0.004	
Terrestrial plants, ten spp.	seedling emergence	BAS800 01H[2] BAS800 02H[2]	HD_5 of EC_{50}: 0.22	150	g a.i./ha	681	Yes
		BAS800 01H[2] BAS800 02H[2]		9[D]		41 (off field)	
		M800H07[3]	ER_{25} : 0.2500	0.199	mg/kg dw	0.8	No
		M800H08[3]	ER_{25} : 0.1443	0.199		1.3	Yes
				0.01[D]		0.07	No

[1] Level of Concern (LOC): 1 for earthworms and terrestrial plants; 0.4 for bees.

[2] BAS 800 01 H contains 70% saflufenacil (a.i.) and BAS 800 02H contains 12% saflufenacil (a.i.); both are formulated as water dispersible granules (WG).

[3] Transformation product.

[A] Estimated environmental exposure concentrations (EEC) were based on an application rate of 150 g saflufenacil/ha. Soil EEC was based on a soil density of 1.5 g/cm^3, soil depths of 15-cm for earthworms and 5-cm for plants. EECs for transformation product M800H08 assume 100% conversion from parent

[B] An EEC for oral toxicity to bees is calculated by multiplying the single application rate, in units of kg (i.e., 0.15 kg a.i./ha) by a factor of 29 µg a.i./bee, which gives an EEC in units that match the toxicity endpoint (µg a.i./bee)

[C] An EEC for contact toxicity to bees is calculated by multiplying the single application rate, in units of kg (i.e., 0.15 kg a.i./ha) by a factor of 2.4 µg a.i./bee, which gives an EEC in units that match the toxicity endpoint (µg a.i./bee).

[D] Refinement for spray drift using medium spray quality (ASAE) of 6% drift deposition at 1 m off-field

Table 5 Screening Level Risk Assessment for Non-target Aquatic Species

Organism	Exposure	Substance	Endpoint	EEC[1]	Units	RQ	Level of concern
Freshwater organisms							
Aquatic invertebrate	acute	saflufenacil	EC_{50}/2 >49	0.01875	mg/l	<0.02	Not exceeded
	chronic	saflufenacil	NOEC 0.65	0.01875	mg/l	0.02	
Fish	acute	saflufenacil	LC_{50}/10 >11	0.0185	mg/l	<0.02	
	ELS	saflufenacil	NOEC 1.0	0.01875	mg/l	0.02	
Amphibians[2]	ELS	saflufenacil	NOEC 1.0	0.1	mg/l	0.1	
Algae	chronic	saflufenacil	EC_{50}/2 0.021	0.01875	mg/l	0.9	
		M800H07[3]	EC_{50}/2 >15	0.01875	mg/l	<0.02	
		M800H08[3]	EC_{50}/2 13	0.01875	mg/l	<0.02	
Aquatic vascular plants	chronic	saflufenacil	EC_{50}/2 0.044	0.01875	mg/l	0.43	
		M800H07[3]	EC_{50}/2 >15	0.01875	mg/l	<0.02	
		M800H08[3]	EC_{50}/2 6.0	0.01875	mg/l	<0.02	
Estuarine/ marine organisms							
Crustacean	acute	saflufenacil	EC_{50}/2 4.3	0.01875	mg/l	<0.02	Not exceeded
		M800H07[3]	EC_{50}/2 >49	0.01875	mg/l	<0.02	
Mollusc	acute	saflufenacil	EC_{50}/2 >3.1	0.01875	mg/l	<0.02	
Fish	acute	saflufenacil	LC_{50}/10 >10	0.01875	mg/l	<0.02	
Algae	chronic	saflufenacil	EC_{50}/2 0.09	0.01875	mg/l	0.2	

[1] Estimated environmental exposure concentrations (EEC) based on an application rate of 150 g saflufenacil/ha. Water EEC is based on water depth of 15-cm to represent a seasonal water body for amphibians and 80-cm to represent a permanent water body for remaining aquatic organisms. EECs for transformation products M800H07 and M800H08 assume 100% conversion from parent

[2] Amphibian risk assessment is based on fish toxicity data.

[3] Transformation Products.

References

A. List of Studies/Information Submitted by Registrant

1.0 Chemistry

2514140	2014, DACO 3 Chemistry Requirements for the Registration of Manufacturing Concentrates and End-Use Products Formulated from Registered Sources of Active Ingredients, DACO: 3.1.1,3.1.2,3.1.3,3.1.4 CBI
2514141	2014, Container Material and Description, DACO: 3.5.5

2.0 Human and Animal Health

2514142	Use Site Description: DETAIL for Weed Control in Non-Cropland Areas. DACO 5.2
1546817	Study on the dermal penetration of 14C-BAS 800 H in BAS 800 02 H in rats. DACO 5.8
1546816	BAS 800 H: Mixer/loader and applicator exposure assessment following application to fruit tree, nut and vine crops (BAS 800 01 H), for pine plantation and industrial vegetation management (BAS 800 02 H) and to field and row agricultural crops (BAS 800 04 H). DACO 5.4, 5.5, 5.11
1546785	BAS 800 H: Reentry worker exposure assessment following application to fruit tree, nut and vine crops (BAS 800 01 H), for pine plantation and industrial vegetation management (BAS 800 02 H) and to field and row agricultural crops (BAS 800 04 H). DACO 5.9, 5.14

3.0 Environment

4.0 Value

2514143	2015, DATA REQUIREMENT - PART 10: Post-emergence and Residual Pre-emergence Broadleaf Weed Control in Noncropland Areas, DACO: 10.1,10.2,10.2.1,10.2.2,10.2.3,10.2.3.1,10.2.3.4,10.2.4,10.3,10.3.1,10.3.2,10.5,10.5.1,10.5.2, 10.5.3,10.5.4
2514145	2014, DETAIL HERBICIDE RESEARCH AUTHORIZATION 0035-RA-14, DACO: 10.2.3.4
2514146	2013, DETAIL 2013 RESEARCH AUTHORIZATION Data, DACO: 10.2.3.4
2579376	2015, 10.2.4 USE SITE HISTORY: Application to Register DETAIL Herbicide for Broadleaf Weed Control in Non-Cropland Areas, DACO: 10.2.4